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COMPARATIVE CAUSATION

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ABSTRACT: As Calabresi (1996) pointed out, no consideration has been given in recent legal and economic literature to the idea of distributing an accident loss among a faultless tortfeasor and an innocent victim on the basis of the relative causal contribution of the parties to the loss. This criterion of apportionment of liability, which we call "comparative causation," is the object of this paper. We present a brief intellectual history of the principle of comparative causation and provide a positive economic model. In order to identify structural features of the rule, we first consider a rule of pure comparative causation where liability is allocated on the basis of causation, regardless of parties' fault. The economic model brings to light some interesting features of the rule, but also unveils the limits of such a criterion of liability with respect to induced activity and care levels. The paper then extends the economic model to consider the workings of the comparative causation rule in conjunction with negligence rules. Applying the comparative causation rule under a negligence regime induces a combination of incentives that no known liability rule provides.

Under most liability rules, if neither party is at fault the loss is either entirely borne by the victim (e.g., in a negligence-based system) or is shifted entirely on the tortfeasor (e.g., in a strict liability system). Existing legal rules lack explicit ways to apportion the loss between a faultless victim and a faultless tortfeasor.[3]

Law and economics scholars have provided convincing rationales as to when it may be efficient to let some losses rest where they fall (i.e., leaving the victim's loss uncompensated), and when instead efficiency dictates shifting the loss on the tortfeasor. Yet, as Calabresi (1996) lamented, little consideration has been given to the idea of distributing the loss between a faultless tortfeasor and an innocent victim according to their relative causal contribution to the loss.[4] In recent years, some jurisdictions revived a forgotten paradigm of causal apportionment of

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[3] Loss sharing generally takes place under comparative negligence whenever both parties have failed to meet their minimum standards of care in their conduct: see Schwartz, G. (1978); Cooter and Ulen (1986); and Rubinfeld (1987).

[4] In his address as a Dinner Speaker at the Sixth Annual Meeting of the American Law & Economics Association, held in Chicago, May 10-11, 1996, Guido Calabresi suggested comparative causation as a

liability in cases where the traditional subjective elements of a tort were either inapplicable or failed to provide a satisfactory answer. In the mid 1980s the issue of causal apportionment of the loss was also debated in the legal and economic literature (Landes and Posner, 1983; Rizzo and Arnold, 1980 and 1986; Kaye and Aickin, 1984; Wright, 1985; and Kruskal, 1986). Most of these papers looked at appropriate ways to assess causation when joint causes are at work. But as Kaye and Aickin (1984, p. 205) critically noted, no systematic framework had been developed for assessing the effect of a causal apportionment of the loss on the parties' incentives for care and activity levels. Analyzing the efficiency effects of this paradigm of liability, which we call "comparative causation," is the object of this paper.

Section 1 presents a brief intellectual history of the comparative causation criterion and provides some illustrations of the modern revival of such paradigm of liability. Section 2 develops a positive economic model of pure comparative causation, where liability is borne by the parties on the basis of their respective causal contribution to the loss, regardless of fault. We look at the incentive effects of the rule. The model brings to light some interesting features of the rule and unveils its limits in achieving efficient care and activity levels, for both tortfeasors and victims. In Section 3, we apply comparative causation in conjunction with negligence-based liability. The economic model of this rule allows us to evaluate advantages and limitations of the comparative causation principle, providing an explanation for the emergence and actual scope of application of this rule in historical and contemporary legal systems. Section 4 concludes with some considerations on the dilemma of casual apportionment of damages.

1. The Rise and Fall of Comparative Causation in Tort Law

In this Section, we present a brief intellectual history of the comparative causation criterion, offering some historical and modern illustrations of the principle of compensation, and its practical corollary, the principle of causal apportionment of liability. In the following, we refer to the application of these principles as the criterion of comparative causation.

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fertile field for research. Instead of determining who is at fault, the courts would assign liability to each party to the degree that each party was the cause of the accident.

1.1 Origins of Causal Apportionment of the Loss in European Tort Law

The problem of apportioning losses between faultless parties has long been debated in legal theory. Fourteenth century legal scholars and fifteenth century legal humanists first explicitly considered the problem of apportioning losses among faultless parties.[5] In later times, seventeenth century natural law scholars such as Hugo Grotius (1583-1645) and Samuel Pufendorf (1632-1694) critically revisited the Romanistic principle of fault according to which a tortfeasor is responsible for losses that he occasioned only if he is at fault. These scholars challenged the underlying assumptions of the fault principle by asking why a victim should bear losses occasioned by another, even when the victim is not at fault, and formulated an alternative paradigm of liability known as the principle of compensation. The tension between the fault principle and the compensation principle became apparent in the jurisprudential writings of Hugo Grotius, who considered the practical implications of these alternative criteria of liability. Grotius' work is suffused by awareness that the faultiness of an act must be considered independently from the consequences of the act. Grotius proposed moving away from the *fault principle* by adopting the *compensation principle*, suggesting that absent fault, there is no reason to let the loss fall on the innocent victim, just as there is no obvious reason to shift it on the tortfeasor.[6]

In many ways, Grotius' work exemplifies seventeenth century scholars' uneasiness with existing paradigms of liability, with an all-or-nothing approach to the apportionment of liability. Even when damages cannot be apportioned on the basis of the relative fault of the parties (e.g. when neither party is at fault and the loss cannot be spread on the basis of comparative negligence), equitable principles may require spreading the loss between parties. In this context, Grotius observed that according to laws in force in many nations at the time of his writings (i.e., prior to the year 1625), damages were usually divided between both parties when neither party was negligent or there were difficulties in deciding who was at fault in the case (Grotius, 1625, at

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[5] For a broader historical analysis of the evolution of these criteria of liability in medieval Europe, see Parisi (1992).

2.17.21). In those situations, notions of causal contribution provided a viable basis for spreading a loss between the parties.

In the following, we consider the mixed fortune of such a criterion of causal apportionment of the loss. We henceforth refer to this as the criterion of comparative causation.

1.2 The Troubled Evolution of Comparative Causation in Modern Tort Law

The historical doctrines of comparative causation that surfaced in Grotius' times left little mark on subsequent restatements of Western tort law. The idea of an equitable apportionment of a loss among non-negligent parties was not shared by later jurists, such as Domat (1625-1696) and Pothier (1699-1772), and was consequently ignored in the subsequent European codifications of tort law, which remained based solely on the classical principle of fault (e.g., Art. 1382 of the French *Code Civil* of 1804; Paragraph 823 of the German BGB of 1900, etc.). Whoever by his fault caused damage to another was bound to compensate the other. Lacking any fault — or evidence thereof — the loss was to lie where it fell, without any room for causal apportionment of the loss or other forms of equitable adjustment of liability.

In spite of the abandonment of the historical doctrines of comparative causation by modern European codes, in recent decades the doctrine of comparative causation has been revived in several jurisdictions. Some developments are quite remarkable, in light of the greater constraints that Civil law courts face when introducing new legal principles in established areas of law, such as torts.

France and Germany adopted causal apportionment standards since the 1800s (Prentice, 1995, n. 44). Current French jurisprudence continues to reflect a causal basis of apportioning liability (Palmer, 1988, p. 1327). The French *Cour de Cassation*, the French Supreme Court, applies all liability defenses on a causal basis, and does not recognize "fault" of the victim in isolation in most circumstances. Thus, for example, the "causal impact" of the parties' negligent

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[6] The criterion of causal apportionment of the loss was an important, and possibly unavoidable, corollary of Grotius' equitable approach to liability. In a passage of his *De Iure Belli ac Pacis,* Grotius (1625, at 2.17.13) examined cases in which the link between liability and faultiness was not clearly assessed.

conduct becomes a relevant factor for apportioning damages under a comparative negligence regime.

Due to the influence of Civil law jurisprudence, the principle of comparative causation has reached further than Europe. Traditionally, Japanese courts are committed to finding equitable solution to hard cases. Criteria of causal contribution provide a valid basis for an equitable allocation of damages in torts cases. With causal apportionment, equitable loss spreading can be achieved, whenever traditional criteria of liability would otherwise lead to all-or-nothing outcomes (Yu, 2000; Yoshihsa, 1999). Legal developments in Europe have also focused on this criterion of liability in the field of environmental law. The *Hoge Raad*, the Supreme Court of the Netherlands, applied negligence and comparative causation principles to a series of environmental liability cases in the 1980's.[7]

In recent years, the rule of comparative causation has emerged in the U.S. in the midst of liability systems based on fault or strict liability. The revival of the concept of comparative causation in American courts is however driven by more pragmatic necessities. Comparative causation has at times been applied when it was difficult to evaluate fault (e.g. liability of incapable individuals, etc.) or where it was otherwise desirable to apportion the loss between tortfeasor and victim on the basis of causal imputability (e.g. loss jointly occasioned by faultless individuals).[8]

These historical and doctrinal illustrations share a common methodological foundation, given the use of causation for the spreading of the loss among faultless parties. In Section 2, we consider an economic model of comparative causation where parties respond on the basis of causation, regardless of fault. We refer to this regime as *pure comparative causation.*[9] We study the effects of this rule of comparative causation on the parties' incentives for care and activity

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[7] For further references on Dutch and Japanese trends, see Yu (2000) and Hondius (1999).

[8] For some discussion of recent judicial applications of the comparative causation paradigm, see Gershonowitz (1986) and Clark (1989).

[9] Some scholars have analogized the notion of comparative causation to a system of comparative strict liability. Palmer (1988) suggests that we must recognize the possibility that strict liability can be used as a sliding scale, rather than an exact point of reference. Viewed from this perspective, causation can also be thought of as a continuum and when multiple causes contribute to a given loss (e.g., tortfeasor's activity and victim's activity, multiple tortfeasors, etc.) comparative causation becomes a potential instrument for apportioning losses among the contributing parties. See also Parisi and Frezza (1998a and 1998b).

levels. In Section 3, we consider a second, more complex, version of the comparative causation model, used in conjunction with a negligence rule. Under this regime, liability is primarily apportioned on the basis of negligence, and only residually on the basis of causation. When only one party is at fault, liability is borne entirely by the negligent individual. When both parties are at fault or when neither party is at fault, the loss is instead split between the parties on the basis of their respective causal contribution to the loss. We refer to this second regime of comparative causation as *comparative causation under negligence.*

2. A Model of Pure Comparative Causation

In this Section, we consider a model to highlight the essence of comparative causation. Parties are made to bear a loss proportional to their causal contribution to the loss, regardless of their fault. Three elements contribute to the overall social cost of accidents: the cost of harm occasioned by an accident, the cost of taking precaution, and the cost of reducing the parties' activity levels. All such costs are relevant for the design of liability rules. Social benefits that accrue when parties engage in risk-creating activities are assumed to be fully internalized by the agents.

Following conventional notation, define the benefit function $w(z,x)$ as the injurer's expected income from undertaking activity level z with care x. Increasing care is costly to the injurer and leads to decreasing benefits, hence assume $w_x < 0$ and $w_{xx} < 0$ for all z. Activity level increases benefits up to a point, thus w_z is initially positive but ultimately negative, with w reaching a maximum at $z_p(x)$, and $w_{zz} < 0$.[10] Since increasing care x decreases w, $|w_x|$ is the marginal cost of engaging in additional care. Clearly, w_z is the marginal benefit of engaging in activity level z.

Likewise, let $b(u,y)$ be the benefit function of the victim, where u is the activity level and y is the level of care undertaken by the victim. Assume that b has similar properties to the

[10] The signs of the second order derivatives in our model follow the literature (see, e.g. Shavell, 1987; Landes and Posner, 1987; and Miceli 1997). In general, it is assumed that the second order sufficient conditions hold for our problems.

injurer's benefit function: $b_y < 0$ and $b_{yy} < 0$ for all u, b_u is initially positive but eventually negative, with b reaching a maximum at $u_p(y)$, and $u_{yy} < 0$. Hence, increasing care is always costly to the victim, and in the relevant range an increase in activity level increases the victim's benefit.

Let $D(x,y)$ be the expected damages per unit of activity where levels of care reduce expected accident costs at a diminishing rate, and the levels of care taken by the two parties are substitutes: $D_x < 0$, $D_y < 0$, $D_{xx} > 0$, $D_{yy} > 0$ and $D_{xy} > 0$.[11] Total damages are assumed to be $zuD(x,y)$.[12] Since increasing care x decreases D, $|zuD_x|$ can be interpreted as the (social) marginal benefit of an increased level of care x.

Turning our attention to causation, note that several variables, including the parties' activity level and the parties' care, affect the causation of an accident. For example, by decreasing his activity level or by increasing his precaution, an accident is less likely to occur.[13] Our model considers the general case in which each party's behavior potentially contributes to causing a loss. We refer to the parties' individual causal contributions to the accident as *causal inputs*. The causal inputs positively depend on activity and care levels: $c^I(z,x)$ and $c^V(u,y)$, where the superscripts *I* and *V* refer to the injurer and the victim, respectively.[14] Further, we assume that $c_z^I > 0$, $c_u^V > 0$, $c_x^I < 0$, and $c_y^V < 0$. This means that the lower the activity level undertaken by one party, the smaller the corresponding causal contribution to a resulting

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[11] Our results do not depend on the assumption that the two parties' levels of care are substitutes. This assumption was adopted and conditions the result in several bilateral precautions models, e.g., see Miceli (1997, p.18).

[12] The product of activity levels *zu* follows the formulation of Shavell (1980a).

[13] Generally, causation is something that each party affects, but no one fully controls. For example, additional precaution or reduced activity levels make it less likely for a party to "cause" an accident, but we assume that no positive and finite value of care or activity can bring causation to zero.

[14] This formulation encompasses the case of other particular liability regimes according to which a loss is apportioned on the basis of factors (e.g., market share) that are related to the parties' activity levels. In the following discussion, we thus think of the criterion of comparative causation as representative of this broader class of liability regimes. Although different labels (e.g., comparative causation, comparative strict liability, market share liability, etc.) would best describe the resulting liability regime in these other cases, qualitatively similar results would obtain from an economic point of view.

accident. Likewise, the greater the care of one party, the less is the party's causal contribution to a resulting loss.

As has been extensively debated in the literature, each party's causal input should not be evaluated in isolation, since in some cases both inputs affect causation of an accident additively, while in other cases they do so multiplicatively, or a mix thereof (Landes and Posner, 1983; Rizzo and Arnold, 1980 and 1986; Kaye and Aickin, 1984; Wright, 1985; and Kruskal, 1986).[15] We illustrate our results with respect to cases where causal inputs are complements and where they are substitutes. The case of causal complements is illustrated by a multiplicative causal relationship: the overall causation factor is given by the product of the parties' causal inputs $c^I(z,x)\,c^V(u,y)$.[16] The case of causal substitutes is illustrated by an additive causal relationship: the overall causation factor is given by the sum of the parties' causal inputs $c^I(z,x)+c^V(u,y)$.[17] In both cases, the causation factor operates as a scale that is multiplied by total damage.

In our model of pure comparative causation, the injurer and the victim share a loss on the basis of their respective causal contributions to the loss, regardless of fault. We now consider the effect of this apportionment rule on the parties' incentives, looking at the cases of causal complements and causal substitutes in turn.

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[15] A comparative causation rule would generally consider the causal potency of different actions or potential sources of harm with knowledge of how events unfolded. Scholars have considered the problem and formulated practical frameworks for the comparative ascertainment of causation. See, for example, Martin (1989) and Pearl (2000). Absent information about actual causation, application of comparative causation rests on probabilistic information alone (e.g., the likely incidence of a given conduct on the probability of an accident, etc.).

[16] Strassfeld (1992) notes, however, that this approach needs evidence such as scientific laws, statistical, historical and psychological generalizations. In other words, comparative causation analysis requires evidence regarding either divisibility of the harm suffered, or availability of substitutes for one or more causes.

[17] Where the causes are apparent and the causal effects are additive, it is easy to apportion liability on the amount of causation. Strassfeld (1992, p. 937 and 941-944) finds that causal apportionment in additive cases allows the court to consider causes of each impact independently, facilitating a more workable comparison. Whenever possible, the importance of one cause in the actual case should be determined on the basis of its actual contribution or impact, rather than on mere statistical information.

2.1 *Causal Complements*

We begin by considering the case in which the parties' behaviors act as complements for the causation of a loss and assume a multiplicative causal relationship given by the product of the parties' inputs: $c^I(z,x)\,c^V(u,y)$. The social optimization problem is then given by:

$$\max_{z,\,x,\,u,\,y} \quad w(z,x) + b(u,y) - c^I(z,x)\,c^V(u,y)\,z\,u\,D(x,y)\,.$$

Suppressing the arguments inside all functions, the socially optimal levels z^*, x^*, u^*, y^* are given by the following first order conditions:

$$w_z = c_z^I\,c^V z\,u\,D + c^I c^V u\,D \qquad (1)$$

$$|w_x| = |\,c_x^I\,c^V z\,u\,D\,| + |\,c^I c^V z\,u\,D_x| \qquad (2)$$

$$b_u = c^I c_u^V z\,u\,D + c^I c^V z\,D \qquad (3)$$

$$|\,b_y| = |\,c^I\,c_y^V\,z\,u\,D\,| + |\,c^I c^V z\,u\,D_y| \qquad (4)$$

Each equation expresses the standard optimality condition according to which social marginal benefit equals social marginal cost.[18] In particular, equation (1) indicates that the social marginal benefit of the injurer's activity equals the social marginal cost, SMC_Z, of his activity level.[19] The first term of SMC_Z originates from the fact that an increase in the injurer's activity level increases the likely causation of an accident, while the second term denotes that an increase in activity level z increases the expected accident loss. Both effects of an increase in z are socially relevant, since they increase the overall cost of accidents. Since all partials in equation (2) are negative, we expressed all such terms in absolute values. Equation (2) says that, at the social optimum, the private marginal cost of the injurer's care should equal the social marginal benefit of increased care chosen by the injurer. The social marginal benefit of increased care,

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[18] We assume that second order conditions hold for this social optimization problem.

[19] This equation implies $w_z(z^*, x^*) > 0$, which in turn implies $z^* < z_p(x^*)$.

SMB_X, has two parts. The first part is the impact of care on the causation of an accident, while the second part represents the impact of injurer's care on total damages.

In a regime of pure comparative causation, we assume that the shares of damage borne by the injurer and the victim are $\frac{c^I(z,x)}{c^I(z,x)+c^V(u,y)}$ and $\frac{c^V(u,y)}{c^I(z,x)+c^V(u,y)}$, respectively. Note that each damage share is affected by the parties' choice of care and activity level. Hence, the greater the care of one party, the less the party's share of the resulting loss. Likewise, the less the activity level undertaken by one party, the smaller the share of damages borne by the party.[20]

Under this regime of liability, the optimization problem confronting a potential injurer is given by:

$$\max_{z,x} \quad w(z,x) - \frac{c^I(z,x)}{c^I(z,x)+c^V(u,y)} c^I(z,x)\, c^V(u,y)\, z u D(x,y)$$

Suppressing the arguments inside the functions, the first order conditions characterizing the levels of z and x, given u and y, chosen by the injurer are the following:[21]

$$w_z = \frac{c^{I\,2} + 2c^I c^V}{(c^I + c^V)^2} \cdot c_z^I\, c^V z\, u\, D + \frac{c^I}{c^I + c^V} \cdot c^I c^V u\, D \qquad (5)$$

$$|w_x| = \frac{c^{I\,2} + 2c^I c^V}{(c^I + c^V)^2} \cdot \left| c_x^I\, c^V z\, u\, D \right| + \frac{c^I}{c^I + c^V} \cdot \left| c^I c^V\, z\, u\, D_x \right| \qquad (6)$$

Comparing (5) to (1), the LHS (left hand side) of each represents marginal benefit from the activity. Note that each term on the RHS (right hand side) of (5) is a fraction of the two terms on the RHS of (1). Thus, the injurer's private marginal cost of activity falls short of the

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[20] This model can easily be adapted to study the workings of market share liability and related criteria of liability, such as liability based on industrial output, annual mileage, etc. In recent case law, the imposition of liability according to such a "market share" basis is not uncommon. This often happens when a victim cannot identify the specific tortfeasor, but can nevertheless identify the class of product that occasioned the injury, (see, e.g., *Sindell v. Abbott Laboratories*, 607 P.2d 924 [Cal.]; *Hymowitz v. Lilly*, 73 NY2d 487). In assessing liability in these cases, defendants are held liable in proportion to their shares of market sales. This bears a close analogy to our hypothetical rule, where harm is allocated between two parties on the basis of their respective shares of activity level.

[21] We assume that second order conditions hold for this private optimization problem.

corresponding social marginal cost. Hence potential injurers undertake too much activity compared to the social optimum. That is, the injurer's private choice of activity level, z_{CS}, exceeds the social optimum, $z^* < z_{CS}$, because potential tortfeasors expect to share the loss with their victims upon occurrence of an accident.

Next compare equations (6) and (2). The LHS of (2) and (6) represent the marginal cost of the injurer's care. The RHS of (6), the private marginal benefit of increased care, is again a fraction of the corresponding social marginal benefit, the RHS of (2), since each component of private marginal benefit is a fraction of the corresponding component of social marginal benefit. Since private marginal benefit falls short of social marginal benefit, the potential injurer undertakes less care than is socially desirable. That is, the injurer's care level, x_{CS}, is less than the socially optimal level $x_{CS} < x^*$, because a potential tortfeasor does not fully internalize the social marginal benefit of his care level.

For similar reasons, in a regime of pure comparative causation the victim also rationally undertakes less than optimal care and engages in too much activity, regardless of the care and activity choices of the tortfeasor.[22] The comparative causation equilibrium results from such dominant strategies of the victim and the tortfeasor in adopting care and activity levels.[23] Private incentives induce each party to choose inadequate levels of care and excessive activity levels because both parties expect to share a portion of the loss with the other party.

2.2 Causal Substitutes

We now study the alternative case in which the parties' actions can be considered substitute inputs in the causation of a loss. We illustrate this case with an additive causal relationship. The causation of an accident is determined by the sum of the parties' causal inputs $c^I(z,x) + c^V(u,y)$.

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[22] Miceli (1997, p. 28-29) observes that if both parties cannot simultaneously bear the full liability in equilibrium, they cannot be induced to choose optimal activity levels at the same time.

[23] This similarity renders any labeling of the parties as "victim" or "tortfeasor" unnecessary, given that both bear the loss in case of an accident.

Under this scenario, the social optimization problem is given by:

$$\max_{z,x,u,y} \quad w(z,x) + b(u,y) - [c^I(z,x) + c^V(u,y)]\, z\, u D(x,y)\,.$$

Suppressing arguments inside the functions, the socially optimal levels z^*, x^*, u^*, y^* are given by the following first order conditions:

$$w_z = c_z^I z\, u D + (c^I + c^V) u D \qquad (7)$$

$$|w_x| = |c_x^I z\, u D| + |(c^I + c^V) z\, u D_x| \qquad (8)$$

$$b_u = c_u^V z\, u D + (c^I + c^V) z D \qquad (9)$$

$$|b_y| = |c_y^V z\, u D| + |(c^I + c^V) z\, u D_y| \qquad (10)$$

As in the causal complements case, the social marginal cost of the parties' activity level has two components. The first originates from the fact that an increase in activity levels increases the likely causation of an accident. The second follows because an increase in activity level may also increase the expected accident loss. Similarly, the social marginal benefit of care for the two parties has two components, one arising from the impact of the parties' care on causation and the other from a resulting decrease in accident loss.

The injurer's private problem is then:

$$\max_{z,x} \quad w(z,x) - \frac{c^I(z,x)}{c^I(z,x) + c^V(u,y)} [c^I(z,x) + c^V(u,y)]\, z\, u\, D(x,y)\,.$$

This is equivalent to:

$$\max_{z,x} \quad w(z,x) - c^I(z,x)\, z\, u\, D(x,y)\,.$$

The private choice of the injurer is characterized by the following conditions:

$$w_z = c_z^I\, z\, u D + c^I\, u D \qquad (11)$$

$$|w_x| = |c_x^I\, z\, u D| + |c^I\, z\, u D_x| \qquad (12)$$

Comparing equation (11) with the socially optimal condition (7), we see that only the second terms on the RHS are different. In particular, the second term on the RHS of (11) is part of the

second term on the RHS of (7). Hence, as before the injurer internalizes only part of the social marginal cost of his activity level and thus carries out too much activity. Likewise, the second term on the RHS of (12) is smaller than the second term on the RHS of (8). This suggests that the injurer internalizes only part of the social marginal benefit of his care level and thus undertakes too little care.

In this regime, the victim rationally undertakes less than optimal care and engages in too much activity. These strategies are dominant and occur regardless of the care and activity choices of the tortfeasor. Thus, the comparative causation equilibrium with causal substitutes is qualitatively similar to the equilibrium identified in the case of causal complements: both parties choose inadequate levels of care and excessive activity levels because each party expects to share the loss with the other party in equilibrium.

2.3 Pure Comparative Causation versus Traditional Liability Regimes

Turning our attention to differences between models of pure comparative causation and other regimes of liability, we first compare the comparative causation rule to negligence rules. The various negligence-based liability regimes, such as negligence, comparative negligence, and negligence with contributory negligence have similar effects on the parties' care and activity level incentives. We therefore consider these systems conjunctly and refer to them as "negligence-based regimes," denoting the relevant values with the subscript *N*. In all negligence-based regimes, the victim bears the full loss in equilibrium, given the Nash strategy of the tortfeasors. This induces the victim to take efficient care: $y_N = y^*$. In turn, this induces the potential tortfeasor to take efficient precautions in order to avoid his primary liability: $x_N = x^*$.[24] In a comparative causation regime, this is not so. Parties face full liability only in the limiting case in which the other party's causation is reduced to zero -- an implausible scenario given positive marginal values of the activity for both parties. This expectation of partial liability by the parties dilutes incentives to undertake optimal care: $x_{CS} < x_N = x^*$ and $y_{CS} < y_N = y^*$.

[24] See, e.g., Shavell (1987), Landes and Posner (1987), and Miceli (1997).

A similar dilution of incentives occurs with respect to the parties' activity levels. In this dimension, however, the results of comparative causation are not necessarily dominated by negligence-based regimes. Under comparative causation both parties face positive expected liability, although their expectation of liability is less than the total accident loss. As a consequence, the tortfeasor's activity level under comparative causation represents an improvement over the equilibrium level induced by negligence-based regimes: $z_{CS} < z_N$. This is because the tortfeasor internalizes some of the benefit from reducing his activity level. Such improvement however comes at the expense of the victim's activity level, since under comparative causation the victim no longer faces the full loss in equilibrium: $u^* = u_N < u_{CS}$.

Symmetrical conclusions are obtained by contrasting the pure comparative causation rule to strict liability with a defense of contributory negligence. We denote the values obtained under this latter regime with the subscript *S*. In a strict liability regime with a defense of contributory negligence, both parties face optimal care incentives. Under pure comparative causation, given the expectation of partial liability for both parties, the incentives to undertake optimal care are diluted: $x_{CS} < x_S = x^*$ and $y_{CS} < y_S = y^*$. A similar dilution of incentives occurs with respect to the parties' activity levels. This creates a tradeoff between improved victim's incentives, $u^* < u_{CS} < u_S$, and reduced tortfeasor's incentives to mitigate activity levels, $z^* = z_S < z_{CS}$.

In conclusion, our comparison of pure comparative causation with traditional liability regimes reveals weaknesses of the comparative causation regime. Unlike traditional liability regimes that induce both parties to adopt optimal levels of care, pure comparative causation generates suboptimal care incentives for both parties, as neither party faces full expected liability. In comparison to traditional liability regimes, pure comparative causation spreads activity level incentives between parties, rather than concentrating such incentives on one or the other party, yielding mixed results with respect to activity levels.

3. Comparative Causation under Negligence

As noted before, comparative causation historically emerges in the midst of legal systems based on negligence, in response to the conviction that, absent fault, there is no obvious reason to

let the loss fall on the innocent victim, just like there is no reason to shift it on the tortfeasor. Loss spreading among faultless parties, in application of the so-called compensation principle, was thus carried out by invoking criteria of causal loss apportionment. In those early applications, the comparative causation rule was invoked in bilateral precaution situations, under negligence-based regimes.[25] The original formulations of the principle of compensation advocated the criterion of comparative causation only when neither the tortfeasor nor the victim was found negligent. Thus the principle of comparative causation only operated as a residual basis of liability in the presence of faultless parties, avoiding the all-or-nothing allocation of liability generated by traditional rules.[26]

This section extends the economic model of pure comparative causation to consider comparative causation in conjunction with fault-based liability. We refer to this regime as *comparative causation under negligence*, since comparative causation is applied with conventional negligence rules. Before presenting the model, we consider difficulties associated with combining negligence rules with sharing rules that utilize causation variables.

3.1 Missing Thresholds and the Troublesome Design of Loss-Sharing Rules

A point of discontinuity in the liability curves faced by the parties must be created to entice both parties to choose optimal care and activity levels. With respect to care, this is generally done by identifying a socially optimal care level and utilizing such level to mark the boundaries between diligence and negligence. Landes and Posner (1987, pp. 70-71) and Gilles (1992) suggest that courts take into account activity levels in their assessment of negligence whenever it is feasible to do so. However, no threshold of "optimal activity level" is generally

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[25] Comparative causation first emerged in legal systems of the Civil law tradition that based liability on fault and generally followed the criterion of comparative negligence for apportioning liability among negligent parties. The Civil law tradition adopted a comparative negligence rule in much earlier times than the Common law. See Parisi (1992).

[26] When neither party is at fault, the comparative negligence criterion does not allow loss spreading between parties. In such a scenario, the entire loss is borne by the victim.

invoked by legal rules as a liability allocation mechanism.[27] The reason for this omission is due to the difficulty of pinpointing a critical value to separate efficient from inefficient activity levels. Absent such critical threshold, no discontinuity in the parties' expected liability can be created.

The difficulty of specifying optimal activity levels is due to the fact that the value of such activities can only be ascertained from private information of the parties.[28] Unlike optimal levels of care, which largely depend on the objective cost of precaution and the expected gravity of harm, optimal activity levels rely on values that are harder to ascertain by a third party decision maker since they include the subjective value of the individual that carries out the risk-creating (or risk-bearing) activity.[29] In the absence of such a threshold it is difficult to induce both parties to internalize the full social cost of their activity levels in equilibrium.

3.2 A Model of Comparative Causation under Negligence

We now present a model of comparative causation under negligence. In this regime, parties share damages only when no unilateral negligence is established. When either the tortfeasor or the victim is found unilaterally negligent, the entire loss is borne by the party at fault. In cases where parties are either both negligent or both diligent, loss-sharing instead follows on the basis of comparative causation. This preserves some essential features of traditional negligence regimes, yet allows loss spreading via comparative causation as a residual basis for apportioning the loss.

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[27] If the due standard of efficient behavior for injurers and victims could also be formulated with respect to optimal activity levels, then liability rules could induce optimal care and activity levels for both parties (Miceli, 1997). The historical emergence of rules of comparative causation partially reflects the difficulties of implementing such an ideal rule.

[28] Miceli (1997, p. 28) suggests that the task of calculating optimal activity levels is prohibitively costly for courts to undertake. As a consequence, negligence is made conditional only on care.

[29] This difficulty is also evident in the mathematical formulation of the activity level problem. Unlike level of care problems, generally modeled as minimization problems, the analysis of care-plus-activity situations is generally reformulated as a maximization problem. This is due to the necessity to account for the private (and social) value of the activity level. If the problem was formulated as a cost minimization problem, the optimal activity level would always be zero. But corner solutions of this sort would be generally undesirable, since risk-creating activities also create private and social value.

Since causal substitutes and causal complements generate similar equilibrium incentives, we concentrate on the case of causal complements. The problem facing the injurer is given by the following:

$$\max_{z,x} \begin{cases} w(z,x) & \text{if } x \geq x^* \text{ and } y < y^* \\ w(z,x) - \dfrac{c^I(z,x)}{c^I(z,x)+c^V(u,y)} c^I(z,x)\, c^V(u,y)\, z\, u D(x,y) & \\ & \text{if } (x < x^* \text{ and } y < y^*) \text{ or } (x \geq x^* \text{ and } y \geq y^*) \\ w(z,x) - c^I(z,x)\, c^V(u,y)\, z\, u\, D(x,y) & \text{if } x < x^* \text{ and } y \geq y^* \end{cases}$$

The problem facing the victim is similar: whenever the victim is diligent and the injurer is negligent, the victim receives full compensation for the loss. If the parties are both negligent or both diligent, they share damages according to the comparative causation principle. If the victim is negligent and the injurer is diligent, the victim bears the total loss without obtaining any compensation from the injurer.

Now consider the behavior of the parties. Note that parties are never induced to take more than socially optimal care, since private marginal benefit of care never exceeds social marginal benefit.

First consider the case in which the injurer chooses his care level expecting the victim to be negligent. The injurer has two options. He may choose to be negligent, sharing liability with the victim on the basis of comparative causation. Alternatively, the injurer may choose to avoid liability by undertaking due care. The injurer's choice of due care only yields a benefit equal to the difference between no liability and partial liability. Next assume that the injurer chooses his level of care expecting the victim to be diligent. The injurer may choose a negligent conduct, facing full liability, or he may undertake due care, sharing the loss with the victim on the basis of comparative causation. In this setting, by adopting due care the injurer again cannot avoid liability entirely. The injurer's choice of due care only yields a benefit equal to the difference between full liability and partial liability.

Note that regardless of the victim's choice of care, the injurer does not fully internalize the full social benefit of his care level. Hence in comparison to the social optimum, the private incentives to provide care are weakened. This opens up the possibility that less than due care is

adopted by the injurer. Unlike the traditional negligence-based regimes, where due care allows the injurer to fully internalize the social benefit of care, diligence strategies are not dominant for the injurer in this case.

Further note that, although not dominant, due care is a possible Nash strategy for the injurer. By reaching the level of due care, a party can capture one of two benefits. In the face of a negligent counterpart, a party can capture the difference between no liability and partial liability. In the face of a diligent counterpart, a party would capture the difference between partial liability and full liability. If these expected gains from due care exceed the additional cost of care, then the party rationally avoids negligence by adopting due care.

A similar logic characterizes care strategies of the victim. As a result of the combination of the parties' strategies, multiple equilibria may obtain. Referring to equilibrium levels of care in the regime of comparative causation under negligence as x_{CN} and y_{CN}, we conclude that $x_{CN} \leq x^*$ and $y_{CN} \leq y^*$.

Similar to the pure comparative causation rule, comparative causation under negligence induces parties to carry out their activity levels beyond the socially optimal levels. Denoting the equilibrium activity levels in the regime of comparative causation under negligence as z_{CN} and u_{CN}, we have $z_{CN} > z^*$ and $u_{CN} > u^*$.

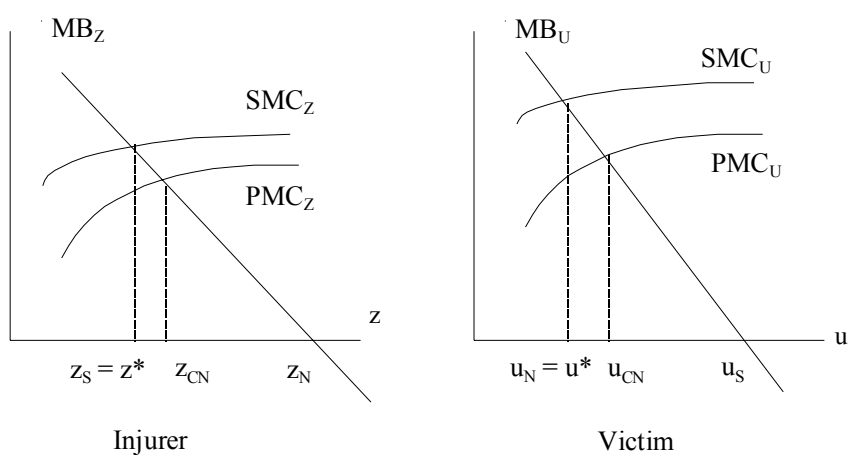

Figure 1

As shown in Figure 1, when evaluated against other traditional liability regimes, comparative causation yields an activity level of the injurer that improves upon the activity level under a standard negligence-based regime, $z_{CN} < z_N$, at the expense of the activity level adopted by the victim, $u_{CN} > u_N$. Comparative causation also yields an activity level of the victim that improves upon the activity level in a standard strict liability-based regime, $u_{CN} < u_S$, at the expense of the activity level of the tortfeasor, $z_{CN} > z_S$.

Once again, these results are due to the fact that, unlike other traditional liability regimes, both parties face positive, albeit not full, expected liability. Absent residual liability, under strict liability with contributory negligence, victims carry out activities until their private optimum is reached: $u_N = u_P$. Likewise, under negligence-based regimes, tortfeasors carry out their activities until the point where private marginal benefit is zero: $z_N = z_P$. Figure 1 compares these points, u_S and z_N, to the activity levels induced by comparative causation, u_{CN} and z_{CN}.

3.3. Summary Results: Comparative Causation at Work

In terms of levels of care, a rule of comparative causation under negligence may induce both victims and tortfeasors to adopt socially optimal levels. This constitutes an improvement over a rule of pure comparative causation, where both parties are induced to adopt suboptimal care levels. In terms of activity levels, both versions of comparative causation fall short of inducing the parties to adopt socially optimal levels.

Difficulties with inducing optimal activity levels for both parties are not unique to comparative causation. As is well known, optimal activity levels incentives are present only for the party that faces the full accident loss in equilibrium. Since it is not possible for both parties to bear the accident loss in equilibrium, most traditional rules fail to provide optimal activity level incentives for both parties, concentrating such incentives on one or the other party. Comparative causation differs from traditional regimes in this respect, since both parties face positive shares of the accident loss in equilibrium. This results in spreading activity level incentives between the parties, rather than concentrating such incentives on one or the other party. As a result, in both versions of comparative causation the activity level chosen by one party improves at the expense

of the other. Thus neither version of comparative causation dominates traditional negligence and strict liability rules on both activity level margins.

Table 1 summarizes the tortfeasor's and victim's equilibrium choices under four regimes: (i) strict liability with contributory negligence, (ii) negligence with contributory negligence, (iii) pure comparative causation, and (iv) comparative causation under negligence. This comparison brings to light the merits and respective limits of alternative loss sharing rules for bilateral precaution cases.

	x	y	z	u
Strict Liability with Contributory Negligence	$x_S = x^*$	$y_S = y^*$	$z^* = z_S$	$u^* < u_S$
Negligence with Contributory Negligence	$x_N = x^*$	$y_N = y^*$	$z^* < z_N$	$u^* = u_N$
Pure Comparative Causation	$x_{CS} < x^*$	$y_{CS} < y^*$	$z^* = z_S < z_{CS} < z_N$	$u^* = u_N < u_{CS} < u_S$
Negligence with Comparative Causation	$x_{CN} \leq x^*$	$y_{CN} \leq y^*$	$z^* = z_S < z_{CN} < z_N$	$u^* = u_N < u_{CN} < u_S$

Table 1

x - care undertaken by injurer
y - care undertaken by victim
z - activity level engaged by injurer
u - activity level engaged by victim

Superscript (*) refers to the social optimal case, subscript ($_S$) refers to the strict liability with contributory negligence regime, subscript ($_N$) refers to negligence-based regimes, subscript ($_{CS}$) refers to the pure comparative causation, and subscript ($_{CN}$) refers to the comparative causation under negligence regime.

These summary results provide us with a key for understanding some peculiar features of the comparative causation rule. If applied in conjunction with traditional negligence rules, application of comparative causation may maintain full incentives for optimal care while spreading the activity level to reduce activity levels between the parties. This is a combination of

features that no other liability rule offers, given the fact that under traditional regimes the residual loss is always concentrated on one or the other party in equilibrium.

In both applications, the loss-sharing and resulting dilution of activity level incentives may or may not increase total net benefits. Further, the creation of such incentives may come at a cost, given the fact that the application of the comparative causation rule under negligence may at times compromise the care incentives. Comparative causation is also likely to exacerbate administrative costs, given the need to ascertain relative causation and the need to adjudicate cases even in situations where neither party is at fault.[30]

The above considerations shed some light on the peculiar historical development of the comparative causation doctrines. In retrospect we can now understand why the early applications of this rule took place in situations involving substantial losses (e.g., the cases of excusable homicide or ship collision found in the seventeenth century). Likewise, we can understand why the rule has continued to thrive in areas of the law where the benefits obtainable from the improved activity level of the parties could justify the increase in adjudication costs (e.g., environmental cases), or where the moderated form of liability produced by the rule was necessitated by concerns of equity or political necessity (e.g. international responsibility of sovereign states).

Further, spreading activity level incentives between parties solves the coordination problem that other rules would create, when labeling one party as tortfeasor or victim is problematic (e.g., in a maritime collision with no fault and mutual losses). Finally, the loss-spreading result in equilibrium may promote optimal risk allocation among risk-averse agents when insurance is not readily available. Loss-spreading may similarly minimize distortion of incentives deriving from truncated liability when tortfeasors face large potential losses.

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[30] The concern for the increase in administrative costs of adjudication was already voiced by Epstein (1980, pp. 134-137) and Landes and Posner (1980, p. 530) who argued that a simple causation rule should be used for the routine adjudication of tort cases.

4. Conclusion: The Dilemma of Causal Apportionment of the Loss

All bilateral precaution rules struggle with a common dilemma. An increase in care level or a reduction in activity level for one party makes an accident less likely to occur. However, each party's precautions make the accident also less likely for the other party. There is no feasible and cost effective mechanism in tort law to induce victims and tortfeasors to internalize the benefits and costs of their behavior in all dimensions.

In spite of this common ontological problem, in this paper we have shown an important qualitative difference between the workings of traditional liability regimes and the allocation of the loss on the basis of causation. In all traditional liability regimes, one party faces the entire loss in equilibrium. Absent parties' fault, victims bear the entire accident loss if subject to a negligence rule, while tortfeasors would bear such full loss under strict liability. This aspect of the traditional liability regimes is at the origin of the historical attempts to formulate alternative criteria of liability that could permit faultless parties to share the accident loss.

The comparative causation principle avoids the imposition of the entire loss on a faultless party. This avoidance poses a different set of problems. In a comparative causation regime, due to the difficulties of identifying socially optimal causation levels and the likely causal contribution of both parties to the accident, the parties share residual liability and expect loss-sharing in equilibrium. The incentives to minimize activity levels follow the allocation of residual liability. Comparative causation consequently yields a dilution of activity level incentives. In a pure comparative causation, care incentives are likewise diluted.

When combined with negligence standards, comparative causation raises the prospect of both parties adopting efficient care levels and yet retains the loss sharing in equilibrium. Further, such rule spreads the residual incentives to control activity levels between both parties. The overall performance of the rule thus depends on the synergies and complementarities between the parties' activities. As a practical matter, adoption of the comparative causation rule in negligence regimes would likely entail larger administrative costs, given the need to evaluate both negligence and relative causation, and to adjudicate cases that would otherwise not be litigated under traditional rules.

These findings help us understand the limited historical success of comparative causation

paradigms. Whenever it is desirable to spread the loss between the parties, comparative causation may be a better legal instrument than most other liability regimes where damage sharing is only a threat which cannot be expected in equilibrium. Thus ex ante comparative causation may appear more appealing when parties are highly risk-averse and when no insurance is available. Additionally, comparative causation paradigms may provide a pragmatic way to allocate liability between faultless parties when the all-or-nothing outcomes of a case are not politically or diplomatically viable. Finally, comparative causation, by spreading the incentives to mitigate activity levels, may decrease net costs in the presence of increasing marginal costs of activity level reduction. In spite of these attributes, the increase in the administrative costs of adjudication is likely to explain the limited success of comparative causation as a general criterion of tort liability.

References

Calabresi, Guido (1975), "Concerning Cause and the Law of Torts: An Essay for Harry Kalven, Jr.," **43** *University of Chicago Law Review* 69.

Calabresi, Guido (1996), Address at the 6th Annual Meeting of the American Law & Economics Association, Chicago, May, 10-11, 1996.

Clark, Carla Ann (1989), "Howard v. Allstate Insurance Company—Louisiana's Attempt at Comparative Causation," **49** *Louisiana Law Review* 1163-1176.

Cooter, Robert D. (1987), "Torts as the Union of Liberty and Efficiency: An Essay on Causation," **63** *Chicago-Kent Law Review*, 522-551.

Cooter, Robert D. and Ulen, Thomas S. (1986), "An Economic Case for Comparative Negligence", **81** *New York University Law Review*, 1067-1110.

Epstein, Richard A. (1980), *Modern Product Liability Law,* Westport, Quorum Books.

Gershonowitz, Alan (1986), "Comparative Causation As an Alternative to, Not a Part of Comparative Fault in Strict Liability", **30** *St. Louis University Law Journal* 483.

Gilles, S. (1992), "Rule-based Negligence and the Regulation of Activity Levels" **21** *Journal of Legal Studies* 319-363.

Grotius, Hugo (1625), *De Iure Belli ac Pacis*, (W. Whewell ed., 1853)

Hondius, E. (ed.) (1999), *Modern Trends in Tort Law*, Kluwer Academic Publishers.

Landes, William M. and Posner, Richard A. (1983), "Causation in Tort Law: An Economic Approach," **12** *Journal of Legal Studies*, 109-134.

Landes, William M. and Posner, Richard A. (1980), "Joint and Multiple Tortfeasors: An Economic Analysis," **9** *Journal of Legal Studies*, 517-555.

Landes, William M. and Posner, Richard A. (1987), *The Economic Structure of Tort Law* (Harvard University Press)

Kahan, Marcel (1989), "Causation and Incentives to Take Care under the Negligence Rule," **18** *Journal of Legal Studies*, 427-447.

Kaye, David and Aickin, Mikel (1984), "A Comment on Causal Apportionment," **13** *Journal of Legal Studies*, 191-208.

Kruskal, William (1986), "Terms of Reference: Singular Confusion about Multiple Causation," **15** *Journal of Legal Studies*, 427-436.

Marks, Stephen V. (1994), 'Discontinuities, Causation, and Grady's Uncertainty Theorem', **23** *Journal of Legal Studies*, 287-301.

Martin, Raymond (1989), *The Past is Within Us: An Empirical Approach to Philosophy of History*, Princeton: Princeton University Press.

Miceli, Thomas J. (1997), *Economics of the Law*, (Oxford University Press)

Orr, Daniel (1991), "The Superiority of Comparative Negligence: Another Vote", **20** *Journal of Legal Studies*, 119-129.

Palmer, Vernon (1988), "A General Theory of the Inner Structure of Strict Liability: Common Law, Civil Law and Comparative Law", **62** *Tulane Law Review* 1303.

Parisi, Francesco (1992), *Liability for Negligence and Judicial Discretion*, 2nd ed., University of California Press (IAS Series).

Parisi, Francesco and Frezza, Giampaolo (1998a), "La Responsabilitá Stocastica," **63** *Responsabilitá Civile e Previdenza* 824-847.

Parisi, Francesco and Frezza, Giampaolo (1998b), "Rischio e Causalita' nel Concorso di Colpa", **44** *Rivista di diritto civile*.

Pearl, Judea (2000), *Causality: Models, Reasoning, and Inference.* Cambridge, UK: Cambridge University Press.

Prentice, Robert A. (1995), "Can the Contributory Negligence Defense Contribute to a Defusing of the Accountant's Liability Crisis?" **13** *Wisconsin International Law Journal* 359, n44.

Rizzo, Mario J. and Arnold, Frank S. (1980), "Causal Apportionment in the Law of Torts: an Economic Theory," *Columbia Law Review*, 1399-1429.

Rizzo, Mario J. and Arnold, Frank S. (1986), "Causal Apportionment: Reply to the Critics," **15** *Journal of Legal Studies*, 219-226.

Robinson, Glen O. (1985), "Probabilistic Causation and Compensation for Tortious Risk," **14** *Journal of Legal Studies*, 779-798.

Rubinfeld, Daniel L. (1987), "The Efficiency of Comparative Negligence," **16** *Journal of Legal Studies*, 375-394.

Schwartz, Gary T. (1978), "Contributory and Comparative Negligence: A Reappraisal," **87** *Yale Law Journal*, 697-727.

Shavell, S. (1980a), "Strict Liability versus Negligence", **9** *Journal of Legal Studies*, 1-25.

Shavell, S. (1980b), "An Analysis of Causation and the Scope of Liability in the Law of Torts", **9** *Journal of Legal Studies*, 463-516.

Shavell, S. (1985), "Uncertainty over Causation and the Determination of Civil Liability", **28** *Journal of Law and Economics*, 587-609.

Shavell, S. (1987), *Economic Analysis of Accident Law* (Harvard University Press)

Strassfeld, Robert (1992), "Causal Comparisons", **60** *Fordham Law Review* 913.

Twerski, Aaron (1978), "The Many Faces of Misuse: An Inquiry into the Emerging Doctrine of Comparative Causation", **29** *Mercer Law Review* 403-432.

Wright, Richard W. (1985), 'Actual Causation vs. Probabilistic Linkage: The Bane of Economic Analysis', **14** *Journal of Legal Studies*, 435-456.

Yoshihsa, Nomi (1999), "Environmental Liability in Japan", *in Modern Trends in Tort Law*, Kluwer Academic Publishers (Ewould Hondius ed. 1999).

Yu, Li (2000), "Book Review: Modern Trends in Tort Law: Dutch and Japanese Law Compared", **6** *Columbia Journal of European Law* 147-148.